



Science Enabled by Gateway

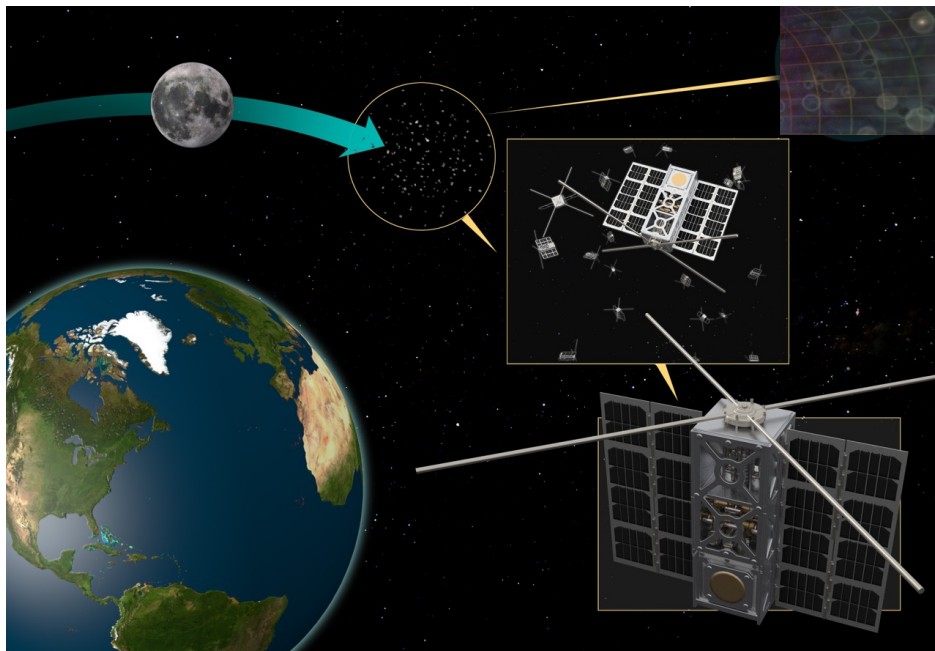
Joseph Lazio

2018 November 8

Space-Based Radio Astronomy

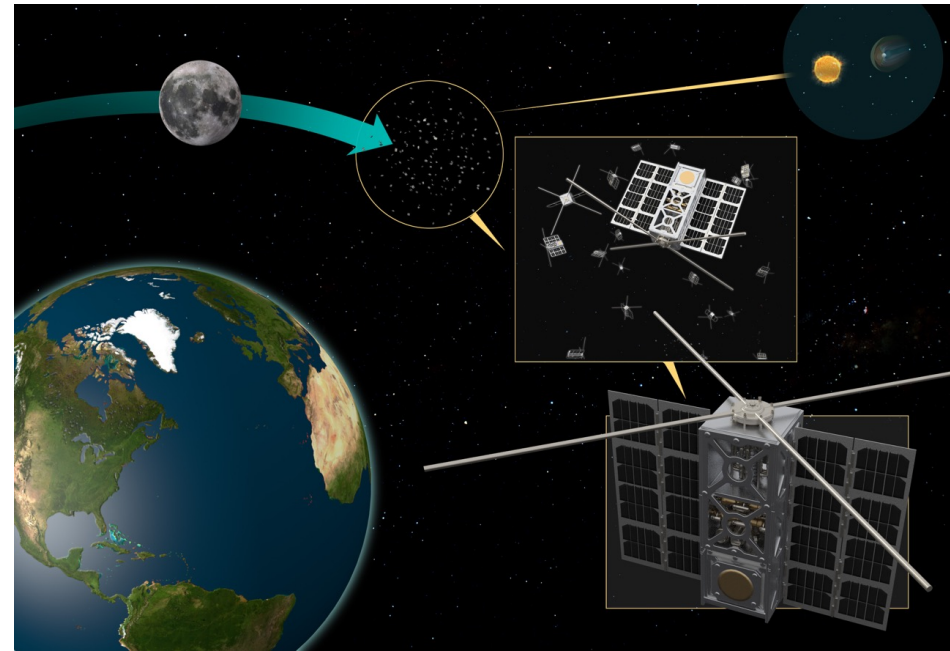
Compelling Science!

Neutral Hydrogen in the Cosmic Dark Ages



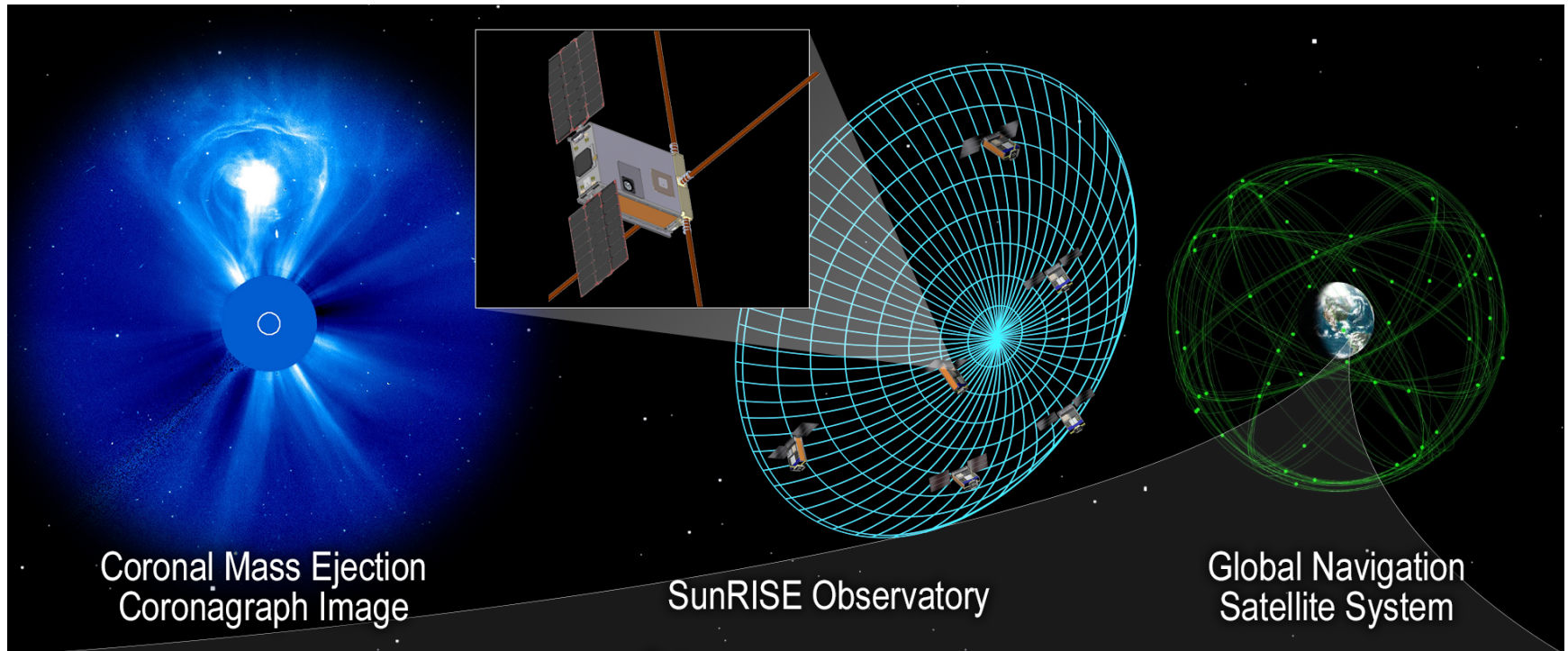
Furlanetto, Oh, & Briggs “Cosmology at low frequencies: The 21 cm transition and the high-redshift Universe”

Extrasolar Planetary Magnetospheric Emissions



viz. W. M. Keck Institute for Space Studies “Planetary Magnetic Fields: Planetary Interiors and Habitability” (Lazio, Shkolnik, Hallinan, et al.)

Sun Radio Interferometer Space Experiment (SunRISE)



Heliophysics SMEX Mission of Opportunity (\$55M cost cap)

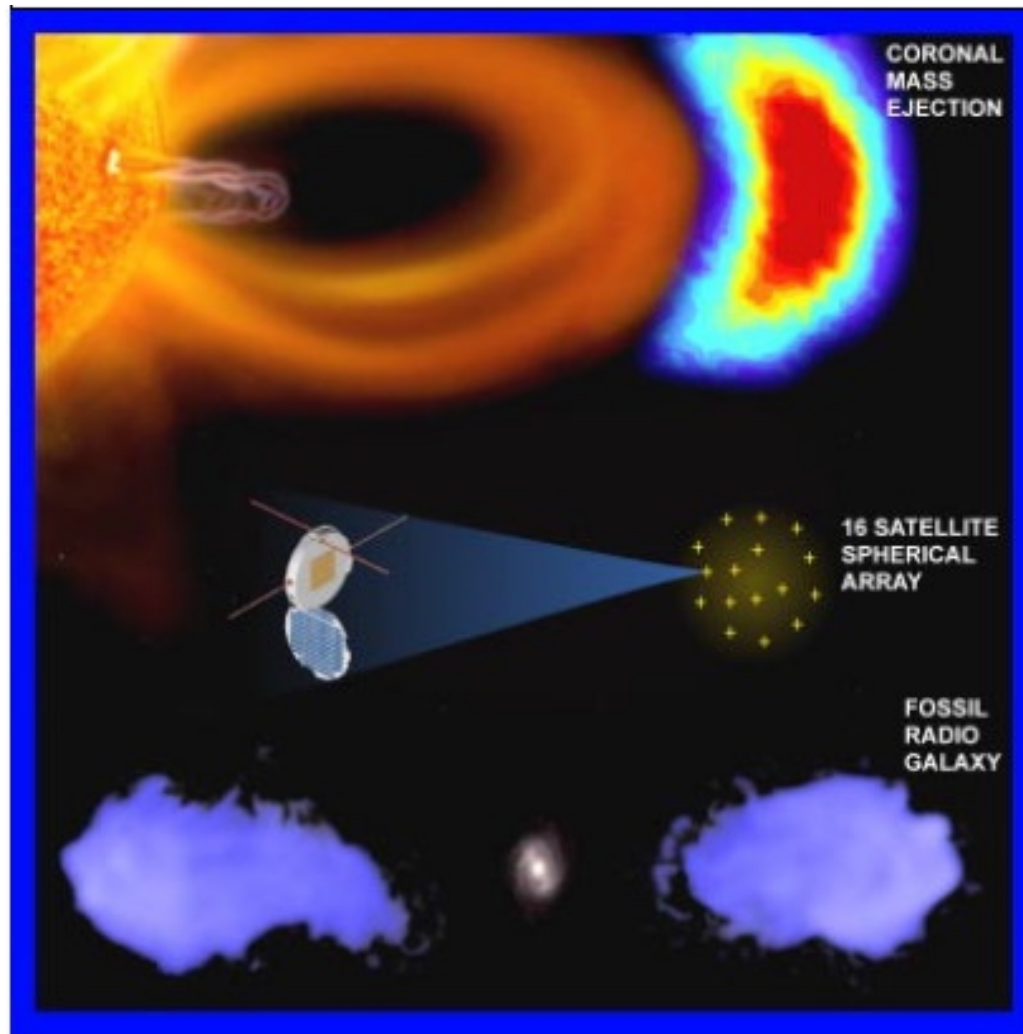
Phase A	2018 July 30
Phase B	2019 January (<i>notional, if selected</i>)
Launch	2022 April (<i>notional</i>)

6 SunRISE
S/C (84 kg) <
Apollo 11
ALSEP (92 kg)

backup

Nothing New Under the Sun

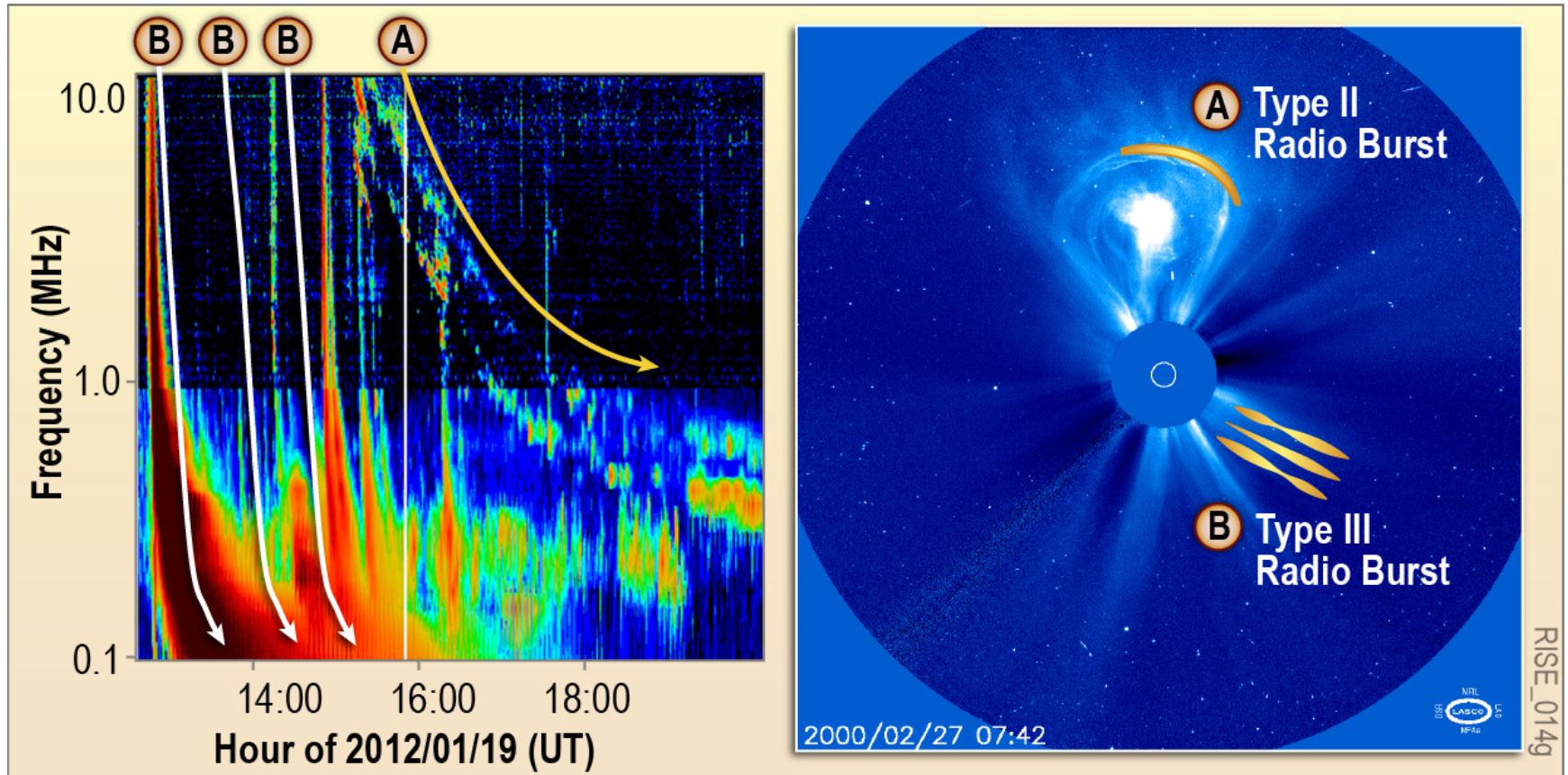
Astronomical Low Frequency Array (ALFA) concept



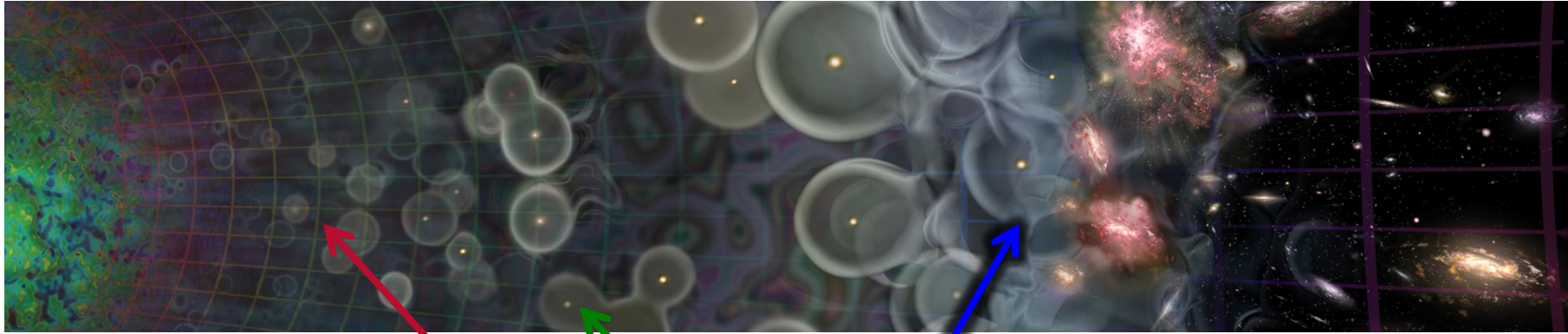
cf. LFSA, SIRA,
DARIS, FIRST,
OLFAR, SURO,
NOIRE, ...
concepts

Solar Radio Emissions (Decametric-Hectometric)

Particle Acceleration and Transport



Hydrogen Signal from Cosmic Dawn and Dark Ages



Neutral Hydrogen 21 cm
spin-flip transition provides
probe of neutral
intergalactic medium
before and during
formation of first stars

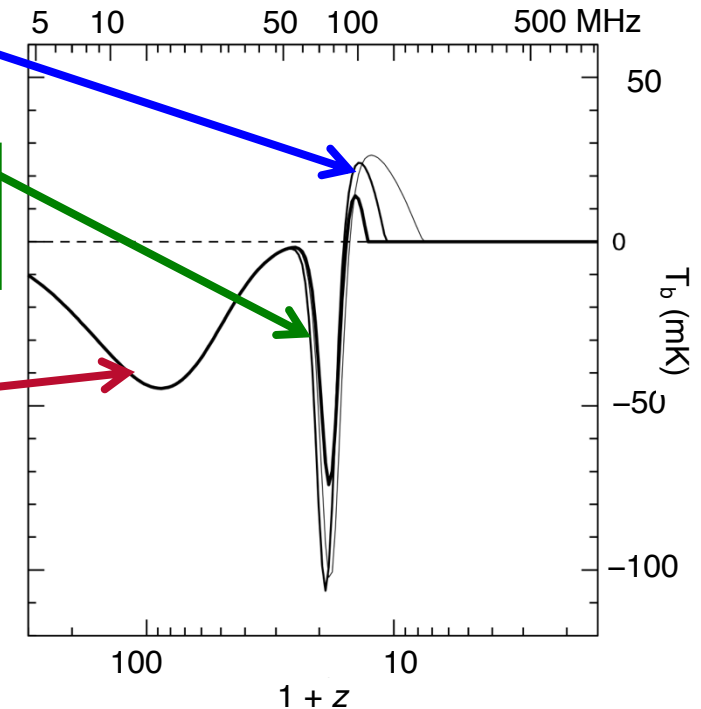
$$\nu = 1420 \text{ MHz}/(1 + z)$$

$$\lambda = 21 \text{ cm } (1 + z)$$

EoR

**Cosmic
Dawn**

**Dark
Ages**



Planetary Radio Emissions

Magnetospheres and Habitability?

